



UNITED STATES PATENT AND TRADEMARK OFFICE

H.A

UNITED STATES DEPARTMENT OF COMMERCE
United States Patent and Trademark Office
Address: COMMISSIONER FOR PATENTS
P.O. Box 1450
Alexandria, Virginia 22313-1450
www.uspto.gov

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/762,666	01/22/2004	Carlos Dangelo	NANOC002NP	5164
24341	7590	07/17/2006	EXAMINER	
MORGAN, LEWIS & BOCKIUS, LLP. 2 PALO ALTO SQUARE 3000 EL CAMINO REAL PALO ALTO, CA 94306			PAREKH, NITIN	
			ART UNIT	PAPER NUMBER
			2811	

DATE MAILED: 07/17/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.		Applicant(s)	
	10/762,666		DANGELO, CARLOS	
	Examiner		Art Unit	
	Nitin Parekh		2811	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --
Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 02-08-06.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-21 and 28-32 is/are pending in the application.
- 4a) Of the above claim(s) 1-21 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 28-32 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 22 January 2004 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date. _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Request for Continued Examination

1. A request for continued examination (RCE) under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 6-16-06 has been entered. An action on the RCE follows.

Claim Rejections - 35 USC § 103

2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. Claim 28 is rejected under 35 U.S.C. 103(a) as being unpatentable over Dahl et al. (US Pat. Application Pub. 2002/0130407) in view of Cromwell (US Pat. 5926370).

Regarding claim 28, Dahl et al. disclose an integrated circuit (IC) chip substrate/die having enhanced power dissipation and improved heat transfer structure (see Fig. 6C), the IC chip/die comprising:

- a substrate (601 in Fig. 6C) having a top surface upon which power generating devices of the IC are fabricated (see sections 0116 and 0136; 601/901 in Fig. 6/9 respectively) and a back/bottom surface essentially parallel to the top surface
- a plurality of cavities/holes (see 633/634 in Fig. 6C) extending a predetermined distance from the bottom surface to the top surface, the predetermined distance being less than the distance between the top and bottom surfaces, the cavities/holes being filled with heat conductive media (HCM) in a form of heat conducting conduits or heat pipe including highly thermally conductive medium comprising a variety of diamond containing material (sections 0007 and 0118-0122) and the cavities/holes being distributed/located directly below the IC devices/power generating devices of the substrate to provide the heat removal from the desired areas of the substrate (see Fig. 6C)
- the HCM having thermal conductivity greater than the substrate/silicon, and
- the heat produced by the IC devices/power generating devices being transferred to the back/bottom surface via the HCM

(Fig. 6C; sections 00116-0122).

Dahl et al. fail to teach the HCM comprising copper.

Cromwell teaches a heat dissipation/heat sink structure using conventional heat pipes (31 in Fig. 4b) where the heat pipes are made of conventional metal such as copper (Col. 10, line 22; Col. 9 and 10).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the HCM comprising copper as taught by Cromwell as an obvious alternative serving the purpose of heat management/dissipation in Dahl et al's IC cooling structure.

4. Claims 29-32 are rejected under 35 U.S.C. 103(a) as being unpatentable over Dahl et al. (US Pat. Application Pub. 2002/0130407) in view of Montgomery et al. (US Pat. Application Pub. 2003/0117770).

Regarding claims 29 and 30, Dahl et al. disclose an integrated circuit (IC) chip substrate/die having enhanced power dissipation and improved heat transfer structure (see 601 in Fig. 6C), the IC chip/die comprising:

- a substrate having a top surface upon which power generating devices of the IC are fabricated (see sections 0116 and 0136; Fig. 6 and 9) and a back/bottom surface essentially parallel to the top surface
- a plurality of cavities/holes (see 633/634 in Fig. 6C) extending a predetermined distance from the bottom surface to the top surface, the predetermined distance being less than the distance between the top and

bottom surfaces, the cavities/holes being filled with heat conductive media (HCM) in a form of heat conducting conduits or rods including thermally conductive medium comprising a variety of diamond containing material (sections 0007 and 0118-0122) and the cavities/holes being distributed/located directly below the IC devices/power generating devices of the substrate to provide the heat removal from the desired areas of the substrate (see Fig. 6C)

- the HCM having thermal conductivity greater than the substrate/silicon, and
- the heat produced by the IC devices/power generating devices being transferred to the back/bottom surface via the HCM

(Fig. 6C; sections 00116-0122).

Dahl et al. fail to teach the HCM comprising carbon nanotubes.

Montgomery et al. teach a thermal interface structure (TIS)/heat dissipation structure wherein the HCM comprises heat conducting rods in form of carbon nanotubes (see 26 in Fig. 4) to provide improved thermal conductivity and heat dissipation between a die and a heat sink for the TIS (sections 0013 and 0017; pp. 1 and 2).

It would have been obvious to a person of ordinary skill in the art at the time invention was made to incorporate the HCM comprising carbon nanotubes as taught by

Montgomery et al. so that the thermal conduction and heat dissipation can be improved in Dahl et al's IC.

Regarding claims 31 and 32, Dahl et al. and Montgomery et al. teach the entire claimed structure as applied to claims 29 and 30 above, wherein Dahl et al. teach the IC devices/power generating devices comprising transistors having source/drain regions (see 902 in Fig. 9; section 0136), such device configuration in the IC package having the plurality of cavities/HCM being distributed/located along the bottom surface of the substrate (see Fig. 6C) provides the cavities/HCM directly below respective source, drain and isolation regions.

Response to Arguments

5. Applicant's arguments filed on 06-15-06 have been fully considered but they are not persuasive.

A. Applicant contends that Cromwell's heat pipes are far too large to be incorporated into the IC die and would require substantial reconstruction/redesign,

However, the primary reference (Dahl et al.) discloses the IC die having the cavities/holes being filled with the HCM in the form of heat conducting conduits/heat pipes to provide the desired heat dissipation/transfer. Cromwell is applied to Dahl et al. to provide the heat pipes made of conventional copper metal material as the heat conductive medium irrespective of the size or the number of the heat pipes.

B. Applicant contends that there is no proper motivation to combine Dahl et al. and Cromwell.

However, as explained in the rejections above, Cromwell is combined with Dahl et al. to provide the HCM comprising copper as an obvious alternative serving the purpose of heat management/dissipation and being suitable for intended use in Dahl et al.'s IC cooling structure.

C. Applicant contends that Dahl et al. and/or Cromwell fail to enable or teach in the structure: 1) how to make copper conduits in fiber form; 2) how to insert from about 1 to 100 copper conduits into the chip; or 3) how to communicate with thermal vias.

However, the references are not necessarily applied for such limitations.

D. Applicant contends that Montgomery et al. do not teach the carbon nanotubes within the IC die.

However, the primary reference (Dahl et al.) discloses the IC die having plurality of cavities/holes (see 633/634 in Fig. 6C), the cavities/holes being filled with heat conducting conduits/rods. Montgomery et al. combined with the primary reference to provide the heat conducting rods in the form of carbon nanotubes.

E. Applicant contends that Dahl et al. and/or Montgomery et al. fail to enable or teach in the structure: 1) how to make carbon nanotubes conduits in fiber form; 2) how

to insert from about 1 to 100 carbon nanotubes conduits into the chip; or 3) how to communicate with thermal vias.

However, the references are not necessarily applied for such limitations.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Nitin Parekh whose telephone number is 571-272-1663. The examiner can normally be reached on 09:00AM-05:30PM.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie Lee can be reached on 571-272-1732. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAN or Public PAG. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAG system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). Any inquiry of a general nature or relating to the

Art Unit: 2811

status of this application or proceeding should be directed to the receptionist whose telephone number is 703-308-0956.

NP

7-7-06



NITIN PAREKH

PRIMARY EXAMINER

TECHNOLOGY CENTER 2800